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RESIDENTIAL SOLAR HOME RESALE ANALYSIS

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ABSTRACT

One of the determinants of the market acceptance of solar technologies in the residential housing sector is the value placed upon the solar property at the time of resale. The resale factor is shown to be an important economic parameter when net benefits of the solar design are considered over a typical ownership cycle rather than the life cycle of the system. Although a study of solar resale in Davis, CA. indicates that those particular homes have been appreciating in value faster than nonsolar market comparables, no study has been made that would confirm this conclusion for markets in other geographical locations with supporting tests of statistical significance. The data to undertake such an analysis is available through numerous local sources, however case by case data collection is prohibitively expensive. A recommended alternative approach is to make use of real estate market data files who compile large data bases and provide multi-variate statistical analysis packages.

1. RESALE AS AN ECONOMIC PARAMETER

1.1 Introduction

The resale of residential solar homes in the real estate market has important implications for homeowners who buy and sell solar properties, for lending institutions that provide permanent financing, and for the rate at which solar applications penetrate the residential housing market. In many instances, life cycle cost (LCC) analysis indicates that investment in solar systems or design techniques for space conditioning and water heating will yield a positive economic benefit to homeowners over the expected system lifetime. However, the average homeowner in the United States moves about once every 5 to 7 years. This means that the accumulated fuel savings over the ownership period amount to a much smaller value than that predicted by a twenty or thirty year LCC analysis. To the extent that the additional capital expense of the solar design can be recouped at the time of resale, the homeowner will realize an incremental profit or loss that can have a significant impact upon the economic benefit of the investment over the ownership period.

In providing permanent financing for solar homes, lending institutions are concerned with the security of the mortgage or real estate loan. Besides evaluating the financial ability of the homebuyer to absorb additional debt burdens (hopefully with consideration of subsequent fuel savings), loan officers must have confidence that the residence can be resold in the event of mortgage default. If the solar portion of the home is viewed as an over improvement, the market or appraised value of the solar home will not reflect the true capital cost of the solar addition which implies the bank must absorb the subsequent loss.

With rising energy costs, solar homes provide a means for insulating the homeowner from increasing operating costs. If passive and active solar homes appreciate at a rate above other nonsolar comparables because of their energy saving features, buyer demand and builder support of solar homes are likely to be stimulated because of their favorable marketing characteristics.

Thus, consideration of residential solar home resale is important for understanding the treatment of energy conserving investments in real estate markets and for properly evaluating the economic viability of solar investments where ownership periods are substantially less than useful system lives. The remainder of this section sets forth the problems of measurement and resale evaluation, and concludes with a discussion of a technique used to evaluate the importance of resale as an economic parameter in Ownership Cycle Cost (OCC) analysis. The following section describes existing analyses of solar resale from actual real estate market data, and the final section establishes the need, requirements, and possible methods for acquiring a statistically significant data set from which more conclusive solar resale analysis can be made.

1.2 Measurement Issues

The goal of residential solar home resale analysis is to determine whether solar features add to, detract from, or have no impact upon market value of homes in the real estate market. The only way to make such a determination is to observe sales and purchase data for solar and comparable nonsolar homes in the same geographic locale over an extended period of time. The sample size must be large enough to establish statistical tests of significance with respect to impact of solar additions upon property values. A myriad of factors influence property values including locational considerations, housing market conditions (interest rates, availability of mortgage funds, demand versus supply, etc.), and individual home characteristics.

Separation of the influence of solar attributes upon property values from all of these other attributes is not a straightforward matter. In fact, property valuation has been the subject of much research and analysis, and a range of statistical techniques (from simple averaging to stepwise regression and systems dynamics) have been used. However, at this point in time, the most severe constraint to solar resale analysis is the lack of compiled data. Without good data, even the most sophisticated real estate analysis technique is rendered useless.

Before discussing some of the scant resale data that has been collected, it might be helpful to analyse the economic importance of resale in relation to other parameters that impact solar system economics.

1.3 A Simplified Sensitivity Model of Resale Value

To illustrate the importance of resale as an economic parameter, a simple structure was formulated to determine the percentage increase or decrease in the residential solar property value required to achieve a target level of annualized dollar savings. The percentage change to achieve the stated savings goal is a function of other economic parameters including the base property value at time of purchase, the solar system incremental cost, simple payback, annual fuel escalation rate over the ownership period, the length of the ownership period, and the remaining financial parameters that normally enter an IRR or LCC analysis (1).

A series of assumptions were necessary in order to simplify the analysis for illustrative purposes. These included the following:

- the solar property has similar attributes as the nonsolar property, with the exception of the solar additions.
- incremental costs of the solar addition are known and the base solar property value (costs without solar) is identical to the nonsolar comparable property value.
- the cost/value ratio for both properties equals one when permanent financing is obtained.
- the mortgage financing terms are the same for both properties.
- the remaining principal on the solar portion of the mortgage is subtracted from the final solar market value to arrive at the net resale profit.

Given these assumptions, two models of solar resale were defined:

(1) The solar home appreciates in value according to two separable rates; the base house appreciates at the same rate as the nonsolar comparable house, but the solar addition appreciates at some other rate which could be higher or lower. This is meant to represent the case of an active solar installation that need not involve a change in the envelope characteristics of the home and where the solar addition is clearly separable.

(2) The solar home appreciates in value according to only one rate which may be higher or lower than the appreciation rate of the nonsolar comparable. This is meant to represent the case of an integral passive solar design that is not easily separable from the base home itself.

Although both models were analysed, only the results for the first model are presented in this paper. Figure 1a through 1c show the total percentage change in solar component market value between purchase date and sale date that is required to achieve the stated level of annualized dollar savings (SAV), for alternative values of annual fuel escalation rate. A family of curves is shown according to ownership period (PI) and simple payback (PBK) of the design. The following conclusions can be made:

- for specified values of PI and fuel escalation rate, the required percentage change gets larger as simple payback period increases.
- for specified values of PBK and fuel escalation rate, the required percentage change gets smaller as PI increases.
- for long ownership periods, short payback periods, and high fuel escalation rates, the solar addition can actually depreciate in value more than its initial cost and the savings target level will still be achieved.
- as the savings target level increases from $0/yr to $1000/yr, the percentage change requirement becomes larger with all other parameters held constant

Fig. 1 Relationship Between Required Percentage Change In Solar Resale Value And Annual Fuel Escalation Rate For Various Values Of PT, PBK, And Annualized Savings.

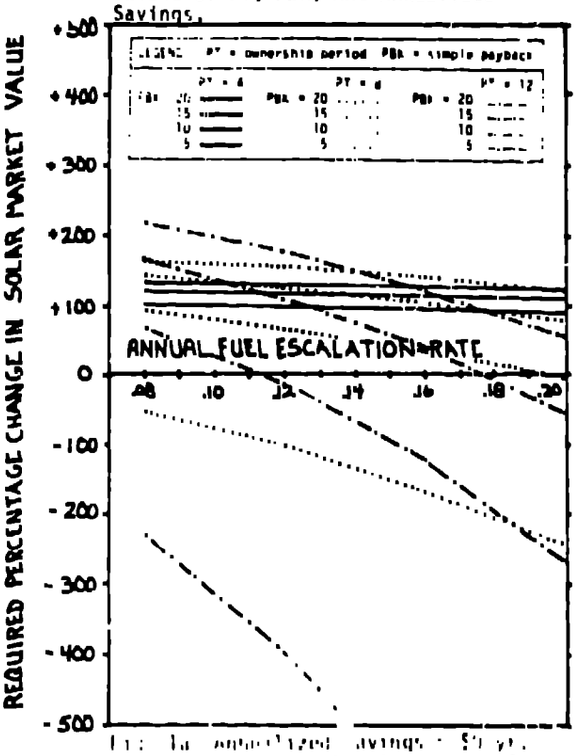

Fig. 1a Annualized Savings = $1/yr.
Incremental Solar Cost = $1.00

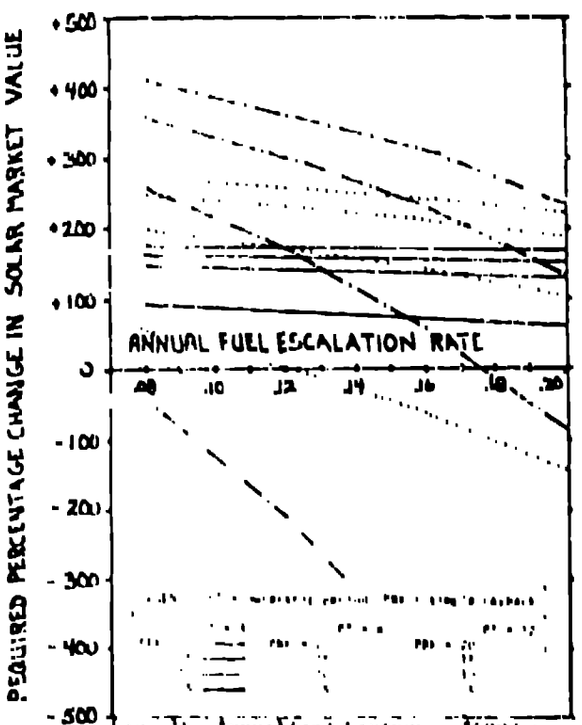

Fig. 1b Annualized Savings = $500/yr.
Incremental Solar Cost = $5000.

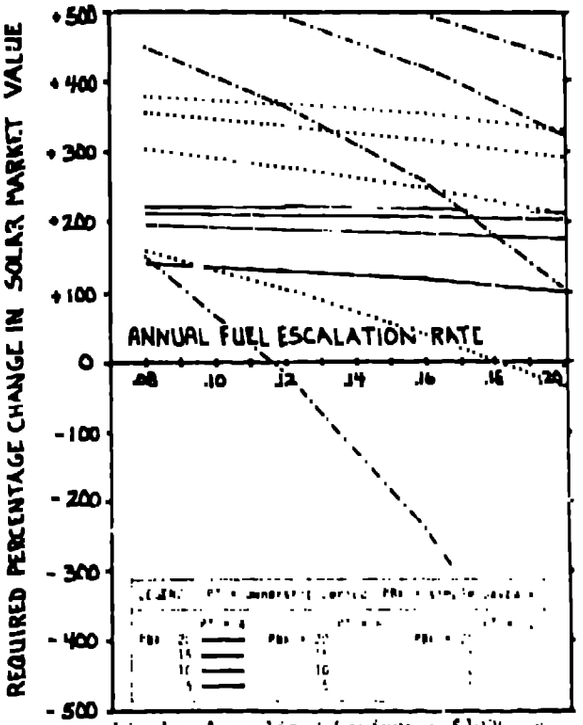

Fig. 1c Annualized Savings = $1000/yr.
Incremental Solar Cost = $[illegible]

• as the solar incremental cost increases from $5000 to $15,000 (not illustrated in Fig. 1), the percentage change required decreases because of the larger initial solar incremental cost. For the zero savings target level, incremental solar cost has no impact on the required percentage change in the solar addition market value.

These figures establish the importance of solar resale valuation especially when taken in the context of other economic conditions. If the solar system is high in initial cost and displaces cheap fuel so the payback period is relatively long, the only way a homeowner can break even or realize positive economic benefits over the ownership period is if the solar addition appreciates at a strong rate over time. However, the irony of the situation is that such solar designs may in fact be viewed as over-improvements because of the high initial expense and low fuel savings and therefore the solar addition is not valued at full cost in the market place.

2. STUDIES OF RESIDENTIAL SOLAR [illegible]

2.1 Discussion

Upon reviewing the literature for solar home resale analysis, talking to individuals at the U.S. Department of Housing and Urban Development (HUD), Franklin Institute, the

Real Estate Research Corporation (RERC), and contacting numerous real estate appraisors, one point became clearly evident: no substantial analysis of residential solar home resale throughout the country has been conducted . In the sections below, brief summaries of resale studies are given and point to the need for data compilation and analysis which is discussed in the final portion of this paper.

2.2 HUD Demonstration Program

The data collection program from Cycles 1 through 5 of the HUD Residential Solar Demonstration Program was conducted by the Boeing Aerospace Corporation with a series of subcontracts to the American Institute of Architects Research Corp. (AIA/RC), RERC, Dubin/Bloome and Associates, and several other organizations . Of the 11,561 grants awarded by HUD, 1216 went to single family residential units, whereas the remaining 10,345 went to multi-family units (2). RERC conducted an interview of 126 Builders who were responsible for 367 single family units. Of these units, only 37 were sold at full cost to the first homebuyer. This is an important point because the first resale can only yield useful information if the conditions of sale approximate those encountered in the normal real estate market. Overall, 37 units out of 1216 would be amenable to resale analysis. In another series of follow-up interviews of HUD home grant purchasers, RERC obtained information from 93 households who were queried about a number of items including resale. Of these 93 homebuyers, [illegible] attempted resales and 1 offer where the home wasn't actually on the market for sale. In terms of actual resale, only 4 families [illegible] of the original 93 homebuyers [illegible]. Of these 4, in only one case was the full cost of the design passed forward. Therefore, in the analysis of HUD demonstration data available as of this writing, only 1 residential solar home resale has been analysed, with no supporting data on comparables in the area collected at the same time.

The data collection effort sponsored by HUD was not designed to collect a comprehensive solar home resale data base. However, as the number of first resales increases in the next several years, an opportunity exists to track the performance of solar homes in the real estate market.

2.3 Davis, California Case Study

The only other study available was an analysis of nine homes resold in the Village Homes Subdivision of Davis, CA. developed by Michael and Judy Corbett Staff at the RERC interviewed the co-developer and realtor of Village Homes to determine initial purchase price and resale price of the solar homes. The average solar incremental cost of the nine homes varied according to the active and passive solar design specifics, but the average cost was about $4000 added to the sale price of the homes. Before the first resale, the houses were owned for a period of time ranging from 15 months to 4 1/2 years. The summary data on these nine solar home resales is from an RERC report (4) and is repeated in Table 1.

"According to Davis realtors, the current annual appreciation rate in their area ranges between 12 and 14 percent. The average appreciation rate for the nine Village Homes resale was 24.5 percent a figure in the high average range for the Davis area. All homes

Table 1. SOLAR RESALES IN VILLAGE HOMES DEVELOPMENT, DAVIS, CALIFORNIA

#	Square Feet	Speculative/ Custom Built	Purchase Price	Purchase Date	Resale Date	Resale Price	Increase $/Year	Selling Time
1	1450	C	51,700	10/76	05/78	62,500	14.2	3 mos
2	1400	S	55,500	07/77	01/79	76,000	24.6	1 mo
3	1500	S	65,000	05/77	09/78	84,000	21.9	1-2 mos
4	1750	S	67,000	01/77	06/78	82,000	15.8	1-2 mos
5	1600	C	68,000	10/77	01/79	84,000	17.3	1 mo
6	1500	S	48,000	06/77	12/78	76,000	49.8	4-5 mos
7	1,200	S	38,500	04/77	08/78	62,000	27.1	4 mos
8	1063	N/A	32,000	05/71	11/79	69,500	44.5	N/A
9	1,200	N/A	44,000	05/76	12/79	69,500	40.9	N/A
			Average: 50,100			Average 72,800	Average 24.4	

Source: Franklin Institute; see reference (4).

dard average, with more than half of the homes achieving resale values above the standard range--perhaps reflecting a higher value placed on homes with lower operating costs. The realtor handling the resales states that houses in Village Homes are 'selling faster and getting more' than other homes in the area" (4).

3. COLLECTING THE NECESSARY DATA

3.1 Case by Case Approach

The RERC interviews examplify the case by case data collection approach. Resale data can be compiled at the local level by interviewing homeowners, developers, real estate agents, and appraisors and by searching through title offices of local county governments. The difficulty with this direct approach is the time required and expense incurred in compiling local data. On the other hand, local interviews allow one to gain a better insight into the specific market conditions and other qualitative information regarding the general acceptance and appreciation of residential solar properties. One recommendation would be to conduct more homebuyer follow-up interviews of HUD solar grant homes. Many of the 1216 residential single family units will be resold in the next 5 years. This provides an opportunity to track the performance of solar properties in real estate markets throughout the country.

3.2 Appraisal Service Data Base Approach

An alternative approach that offers a better means for obtaining larger sample sizes is to make use of the services provided by real estate data collection firms scattered throughout the country. One such firm that this author is aware of is the SREA Market Data Center, Inc. located in Southern California. The Market Data Center provides a subscription service to lenders and appraisors (either independent or with savings and loan institutions) that gives members access to a large computerized real estate data base (5). In addition, a computer software package called MULVAE can be used on a timesharing system that allow the user easy access to comparable market and sales data in a large number of real estate markets. Where the sample size is large enough, multiple regression techniques can be used to construct algebraic equations that are derived from and descriptive of selected housing sales. It should be emphasized that the MULVAE system is not meant to be a substitute for experienced appraisor judgement, rather, it is a cost effective, easy to access system that can help appraisors increase their productivity by saving time in the process of valuing properties.

Subscription members are requested to complete one page data forms that summarize information contained on standard appraisal forms including information on sales price data from real estate contracts. The SREA Market Data Center form includes a box on fuel type used in the home for heating purposes. It should be possible to alter this one item in order to allow distinctions between active and passive space and water heating with alternative backup fuel combinations.

Over time a data base could be generated that would include a categorization of solar system type and other relevant market data. With sale prices reported, regression analysis could be used to determine the influence of solar additions on property market values. Although the data base would take a period of years to accumulate, the benefits would be obvious:

- information on solar penetration in select markets would be obtained.
- the impact of solar additions on property values could be determined using multiple regression techniques.
- a consistent data base would be compiled on other characteristics of solar homes including backup fuel types, construction methods, and so forth.

4. ACKNOWLEDGEMENTS

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5. REFERENCES

(1) Balcomb, et.al. "Chapter 8 Economic Analysis" in Passive Solar Design Analysis Vol. 2 of The Passive Solar Design Handbook, prepared for the Department of Energy, Jan. 1980.

(2) Data from the HUD Residential Solar Demonstration Program was made available by phone from Lance Hoch, of the Franklin Institute in Philadelphia, PA, March 26, 1980.

(3) Roberta Walker at RERC indicated that of the 93 homebuyers interviewed, 17 resales has actually taken place, however, only information on the first 4 resales had been forwarded to Franklin Institute for analysis at the time of this writing.

(4) Franklin Institute, HUD Solar Status Marketing and Market Acceptance Information on Solar Homes, draft report prepared for HUD, available through the National Solar Heating and Cooling Information Center, P.O. Box 1600 Rockville, MD, 20850, March 1980.

(5) Personal interview with John Hicks, President of the SREA Market Data Center, Inc., Arcadia CA., Dec. 27, 1979.